

Winter 12-18-2015

Alarm Management: Electrocardiographic Lead Management

Dale Elaine Dominguez Ms.

University of San Francisco, Dominguez.Dale@gmail.com

Follow this and additional works at: <https://repository.usfca.edu/capstone>



Part of the [Critical Care Nursing Commons](#)

Recommended Citation

Dominguez, Dale Elaine Ms., "Alarm Management: Electrocardiographic Lead Management" (2015). *Master's Projects and Capstones*. 168.

<https://repository.usfca.edu/capstone/168>

This Project/Capstone is brought to you for free and open access by the Theses, Dissertations, Capstones and Projects at USF Scholarship: a digital repository @ Gleeson Library | Geschke Center. It has been accepted for inclusion in Master's Projects and Capstones by an authorized administrator of USF Scholarship: a digital repository @ Gleeson Library | Geschke Center. For more information, please contact repository@usfca.edu.

Alarm Management

Electrocardiographic Lead Management

Dale Dominguez, RN, MSNc

University of San Francisco

School of Nursing and Health Professions

Clinical Leadership Theme

The chosen project theme integrates the master's essential of Quality Improvement and Safety. The identified competency is the process of using researched evidence to create and coordinate system improvement that will speak to trends in safety and quality (AACN, 2013). The defined project will be to reduce the number of electrocardiographic (ECG) alarms in the microsystem by ensuring appropriate ECG lead placement and changing the patient's lead electrodes daily. My role as the Clinical Nurse Leader (CNL) will be to assess the microsystem to define the problem, ascertain the workflow of the unit, and identify the barriers and needs in order to create a project action plan. The action plan will include staff education, surveillance and auditing for compliance and improvement, and staff rounding to assist with the refreezing process, as defined in Lewin's process change theory (University of San Francisco, 2015) thus ensuring that the new process becomes a routine part of the nursing staff's care.

Statement of the Problem

Hospitals today contain numerous pieces of equipment that have alert alarms. These pieces of equipment produce innumerable alerts, many of which are unnecessary and/or low-priority. These nonessential alarms cause clinical staff to become desensitized to the alerts. This desensitization leads to delayed response time and even disabled alarms, posing a safety hazard to patients. The alerts also disrupt patient sleeping patterns, which contribute to sleep disturbances that lead to intensive care unit (ICU) delirium. These sleep disturbances lead to poorer patient outcomes and increased length of stays (LOS). Patient satisfaction rates decrease with the greater level of environmental noise. Nursing satisfaction is also a factor. Nurses found the excessive number of alarms interrupted patient care and led staff to distrust the facilities monitoring systems (Cvach, 2012). Staff timeliness and efficiency will improve as less time is

spent addressing inappropriate alarms. Decreasing alarm alerts will benefit the patient and clinical staff who care for those patients.

Project Overview

The project's microsystem is a 20-bed adult medical surgical ICU in a 186-bed hospital in the Sacramento area. The patient population consists of patients with advanced cardiac, renal, and pulmonary disease, septic shock, gastrointestinal bleeding, and multisystem failure. The nursing ratio is one nurse to two patients unless the patient meets a criterion that indicates that one to one care is required. There are no certified nursing assistants or monitor technologists working in the unit. The charge nurse is usually unencumbered of patients, but is the lead nurse on the rapid response team, in-house code blue team, and stroke team. Because of these duties, the charge nurse's role in watching the central monitoring system to assess alarms is limited. Each nurse is responsible for observing the cardiac monitors for each of their patient's.

The first goal of the project is to have the staff complete an Alarms Management survey/pre-test to assess the ICU nurse's knowledge about alarm fatigue and appropriate lead placement (Appendix A). The second goal involves developing a learning module with the findings from the survey/pre-test, information from an extensive literature search, and information provided from the DignityHealth's regional Alarm Management Committee. The learning module will include expanded information about alarm desensitization, appropriate skin preparation prior to electrode placement, proper lead placement, and daily changing of electrodes. Included is a post-test to evaluate the nurse's comprehension level of the material and provide remediation as needed. The objective of the learning module is to have nursing staff implement these practices into their every day routine. Ninety percent of the ICU staff will be required to complete the learning module. Goal three will be to collect data to assess compliance as a result of the intervention. Daily rounds will be conducted to assess appropriate lead

placement, obtain feedback from staff about the project, answer process questions, and reinforce staff's compliance. Data will be obtained by auditing the patient's electronic medical records (EMR) to assess documentation confirming daily electrode change. Although the current cardiac monitoring system is not able to generate a report identifying the specific types of alarms, hand extracted data will provide basic information about the number of alarms and identify whether the alarms are high or low alert. Baseline alarm data will be collected for comparison with the data obtained at the end of project. Data collected from the rounding and EMR auditing will be posted for staff to view progress and reports will be given to the leadership team and the hospital's risk manager.

The specific aim for this alarm management project is that by August 1, 2015, 100% of the nursing staff in the ICU will have properly placed cardiac monitor leads on their patients. Also, by that date, 90% of the staff will document changing the cardiac monitor electrodes at least once in a 24-hour period. The aim statement relates to the global aim of the project as follows: upon full implementation of the project's process, results will indicate that a) patient safety will increase due to a decrease in alarm fatigue as staff control and manage high-alert alarms; b) staff efficiency will improve as less time is spent addressing inappropriate alarms; and c) both patient and staff satisfaction will increase as the frequency of alarms decrease. These results will ensure better outcomes for the ICU patients.

Rationale

Alarm management is a patient safety issue that has become more prominent in recent years. The Emergency Care Research Institute (ECRI) has named alarm hazards as the number one health technology hazard for 2015 (Top 10 Health Technology, 2014). The need for alarm management to decrease those hazards is crucial. Observation of the microsystem has demonstrated a need for alarm management as an assessment of the microsystem noted delays,

including non-response times from nursing staff to the myriad of alarms that sound. The majority of the alarms were low level, yet no staff attempted to customize the alarms or change electrode pads. On two different occasions patients who had a potentially lethal rhythm (one had a short runs of ventricular tachycardia and one a bradycardia) that were unnoticed for a period of time. Staff finally recognized both of the patients' rhythms and treatments were administered. In addition, during my observation of the ICU, a patient became disconnected from their ventilator and seeing no response from staff members, I quickly entered the room and placed the patient back on the ventilator. Results of the survey/pre-test revealed that when asked how disruptive false clinical alarms are to the daily workflow, 1 being not disruptive and 10 being constantly disruptive, 85% of the staff rated the disruption at a 5 or greater (Appendix B). Sixty percent of the same group of nurses also related that in the past year they had witnessed a delay in response to an urgent patient situation as a result of excessive false clinical alarms (Appendix C). Assessment of the microsystem clearly identified a patient safety risk.

Other analyses that support the project are the results of a hospital gap analysis, that was a modified version of the a gap analysis done the DignityHealth's regional Alarm Management Committee (Appendix D) and a Fishbone diagram (Appendix E) that indicate a lack of alarm management poses a significant increase in the possibility of sentinel events. Completion of a process SWOT analysis (Appendix F) identified areas of needed improvement that support the implementation of the project.

A literature review also revealed the need for alarm management. The Joint Commission released a Sentinel Event Report identified that between 2009 and 2012 there were 98 reported alarm related events (The Joint Commission, 2013). Also in 2013, The American Association of Critical Care Nurses (AACN) released a practice alert addressing the need for alarm management in ICUs (Sandelbach & Jepsen,, 2013).

Justification for the project also occurred as a cost analysis was done. Total cost of the program implementation is approximated at \$5,620 (Appendix G). The benefits include decreased LOS as a result of sleep disturbances that may lead to ICU delirium. According to Thomason, Shintani, Peterson, Pun, Jackson & Ely (2005), delirium can develop in up to 48% of the ICU patients, increasing LOS by one day.

Qualitative benefits include increased patient satisfaction as the result of less disruptive noise during the patient's stay. Increased patient satisfaction is reflected in The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores and effects reimbursement rates. Nurse satisfaction increases in response to a decrease in alarm alerts.

Lastly, the implementation of an Alarm Alert Management Program, which includes ECG lead placement, will meet The Joint Commission's National Patient Safety Goal (NPSG) implementation requirement (The Joint Commission, 2015). Meeting this requirement will help insure reimbursement by Medicare and Medicaid. Evaluating both the safety risk to patients and a potential cost savings supports the rationale for the project

Methodology

Lewin's Change Model will be used for my project. Unfreezing, which is the first step of the change model, brings the issue to the attention of the employees and looks for barriers and problems that may interfere with implementation. Unfreezing was demonstrated as one-on-one time was spent with the ICU nurses, explaining why the program was important, how important their contribution would be, and how the process would work. During this time staff were given information about alarm fatigue and were told about the survey/pre-test that would be used to get their feedback about alarm fatigue, identify any possible barriers, and assess their baseline knowledge on the subject. Actions, or the moving step of the change model, occurred as goals and objectives were developed and an education module for the process was developed. This

education module was based on the survey's findings, recommendations from the AACN, and information provided from the hospital's regions informational huddle on alarm management. After staff completion of the module, unit rounding and auditing of patient EMRs were done. Progress reports were provided to staff and leadership. The last step of Lewin's change module, Refreezing, was demonstrated in the project when the new change became part of routine activities of the nursing staff. Continued monitoring was done to assist in maintaining compliance, get feedback from staff regarding barriers, to promote the project, and to give updates about the progress of the project to leadership for their continued support.

Data collected included results from daily rounding on each patient to evaluate if ECG leads were appropriately placed. Auditing of each patient's medical record was done to verify, through documentation, that the patient's electrodes were being changed daily and alarm data from the cardiac monitoring system was gathered and compared to the baseline data. This data will assist in evaluating the effectiveness of the interventions.

The desired goal will be reached if, by the end of the project, a) rounding audits show appropriate ECG leads placement on 100% of the patients, b) 90% of the charts audited will have documentation as to daily patient electrode change, and c) if baseline data can be obtained, there will be a 5% decrease in alarm alerts.

Data Source/Literature Review

The project focuses on the nursing staff's ability to successfully implement the process of appropriate ECG lead placement and daily electrode change. This success is measured by patient rounding; chart audits, and analyzing alarm alert data that will lead to the project's ultimate goal of decreasing the number of false alarm alerts. The benefits will provide a safer patient environment. The literature review revealed several sources that confirmed the need for alarm management as a means to providing a safe patient environment. Phillips, Ainsworth, Canella,

Crumley, Ellstrom, Fleischman, Moffitt, Radovich, & White (2014) confirmed the need for alarm management and six out of the last eight years the ECRI has listed alarm safety as the number one technology safety hazard. Using the steps of define, measure, analyze, design, and verify from the Six Sigma Process, the authors were able to clearly define the issue and develop a plan of action to address the major issues.

The ECRI (2014), in its annual report, identified alarm safety as the number one potential source of health technology hazard. The danger occurs when clinical staff are not advised when a valid alarm condition develops, or when they are being exposed to an excessive number of alarms, most of which are clinically insignificant. The report noted that inadequate alarm configuration was the major contributing factor to the danger. Policies for alarm configuration should address selecting appropriate alarm limits based on the patient, identifying which alarms can be disabled, and setting appropriate default alarm priority levels.

In a practice alert published by AACN, it was noted that 80% to 99% of ECG monitor alarms are false or do not required an immediate response (Sendelbach & Jepsen, 2013). The alert recommended proper skin preparation prior to placing the ECG electrodes to decrease signal noise and skin impedance. This preparation enhances conductivity, thus decreasing the number of false alarms. Skin should be washed with soap and water or wiped with a rough washcloth or gauze and excess hair should be clipped (Sendelbach & Jepsen, 2013). Daily electrode change was also recommended.

The high rates of false alarms contribute to a noted delay in response time by nursing staff. The staff is aware that a large number of alarms do not require their immediate attention, so the urgency to respond is lessened. Edworthy (2012) noted that many times staff response rates match their understanding of the accuracy of the alarm. If their perception of the accuracy of the alarm is low, perhaps 10%, their response to the alert will also be close to 10%.

The Joint Commission's Sentinel Event database includes reports of 98 alarm-related events between January 2009 and June 2012 (The Joint Commission, 2013). Of the events, 13 resulted in permanent loss of function and 80 resulted in death. More than 90% of the reported events occurred in hospitals. The greatest number of those events occurred in telemetry or ICUs that were found to have staff training deficiencies on the proper use and function of the equipment. The Joint Commission strongly believes that alarm-related events are vastly underreported.

An article by Konkani, Oakley, & Bauld, (2012) provided a study of journal articles and review articles to identify best practices used to decrease the number of nuisance clinical alarms. Results indicated that the practice that reduced the most false alarms was customizing default ECG alarms. Another factor that reduced alarms was the standardization of policies and protocols related to clinical alarm management. The article also concluded that more studies are required to assess the effect of alarm differentiable features and the design of smart alarms.

Alarm alerts also increase LOS due to sleep disturbances that may lead to ICU delirium. In a study of five ICUs done in 2013, environmental noise caused between 11% and 17% of arousal and awakening episodes in patients (Darbyshire & Young, 2013). According to Thomason, Shintani, Peterson, Pun, Jackson & Ely (2005), delirium can develop in up to 48% of the ICU patients when environmental noise is a contributing factor. This delirium may increase LOS by one full day.

Another component of alarm management is the impact of patient satisfaction scores on which the Centers for Medicaid and Medicare Services (CMS) are basing a portion of their reimbursement to hospitals. HCAHPS surveys are used to measure patients' perceptions of their experiences in the hospital. Fifty-three percent of the respondents at the ECRI Institute's 2013 alarm safety web conference identified that alarm issues have impacted their facility's patient

satisfaction scores (Vanderveen, 2014). The provided literature strongly supports the identified need for the alarm management project.

Timeline

A microsystem assessment occurred in the first week of June, which included a unit observation period, a gap analysis (Appendix D), and the completion of a root cause analysis fishbone diagram (Appendix E). The next week a survey/pre-test (Appendix A) was developed using the results of the microsystem assessment and a literature search. The following two weeks the survey/pre-test was distributed to staff completed and returned. An analysis (Appendix F) of the survey/pre-test was done during the next week in preparation for developing an education module. During the first part of July, development of an education plan (Appendix I) occurred and in mid-July the education module was distributed and collect once completed. The last week of July and the first week of August assessment of compliance (Appendix K) to the process change was done. In mid August the results were added to the final paper and PowerPoint presentation. See Appendix H for the completed Gantt chart showing the project timeline.

Expected Results

Expectations were that the number of alarms would decrease after implementation of the process. Unfortunately, the cardiac monitoring system currently used is not readily able to generate clear reports on the number and type of alarms. Limited information will have to be manually extracted from the system. Because gathering the data is such a laborious task, availability to post process information was limited. Another expectation was that although research has shown that alarms can decrease up to 46% in the ICU (Cvach, 2012) with daily changing of electrode pads, the percentage decreased would be less because the survey/pre-test indicated that the majority of the staff were aware of daily electrode changes and some were

currently changing the leads. Indications of the knowledge of daily electrode changes verses daily practice will be evident in the EMR audits that will occur post intervention.

It is expected that appropriate lead placement will increase. The survey/pre-test showed that about 55% of the staff was placing the brown (V1) lead in the incorrect position. Placing the brown lead in the correct position may not lead to a large decrease in alarm alerts, but the accuracy of the displayed rhythm should increase.

Another expectation is that this project would increase the staff's general knowledge about alarm management. This project is just the first of many other processes involving alarm management that will be incorporated in the ICU. The baseline knowledge and the understanding of urgency of change will assist with the next alarm management change process. Customizing the alarm limits will be the next process implemented. The hospital and its sister hospital in the Sacramento area are in the process of purchasing a middleware product that will assist in obtaining more accurate alarm alert data. The Medical Safety Device Committee hopes that the middleware will be installed by the time the alarm customization process begins. Although the middleware may be available, the monitor itself is a less sophisticated model so there will be limitations on what alarms can be customized.

Nursing Relevance

One of the roles of the CNL is to help to ensure a safe environment for the patient. Promotion of an alarm management program will assist in providing that safe environment. The process of skin preparation prior to electrode placement, placing the ECG leads in the correct position, daily electrode changes, and customizing alarms must be incorporated into the clinicians daily routine. These steps will assist in decreasing alarm alerts, thus assisting in decreasing staff alarm fatigue. In addition, it will allow the staff to spend more time with their patients and increase both patient and nursing satisfaction.

The Joint Commission has added alarm management as a NPSG (The Joint Commission, 2015) and is requiring care facilities to implement a Medical Device Alarm Management Program. Compliance to regulatory bodies is a top priority for healthcare institutions and this project will assist in that goal. This is especially important as further alarm management processes will occur in the unit and this first project will provide staff preparation for projects to come.

Evaluation

The aim of the project was to reduce the number of (ECG) alarms in the microsystem by ensuring appropriate ECG lead placement and the daily changing of the patient's lead electrodes. With the implementation of these processes the goal is a 5% reduction in alarm rates in a 24-hour period. The microsystem in which my project was implemented is a 20 bed adult medical ICU in a 186-bed community hospital. The nursing staff is comprised of both experienced and novice nurses. The unit's registered nurse (RN) to patient ratio is one-to-two unless a patient meets a set acuity criteria that indicates that one-nurse-to-one-patient care is required to provide appropriate care to the patient. The unit does not utilize licensed vocational nurses (LVN), nursing assistants (NA), or monitor technicians in the care of the patients. The RN staff is responsible for the operation and surveillance of all of the cardiac monitoring equipment. Because the staff are not able to view the cardiac monitors at all times, they rely on alarm alerts to notify them of needed interventions to the patient. As previously noted, 80% to 99% of ECG monitor alarms are false or do not require an immediate response (Sendelbach & Jepsen, 2013). Because of the high number of false alerts, staff responses to these alerts can be delayed thus causing a possible delay in response to an event that requires immediate attention.

The project began with the distribution of a survey/pre-test to the nursing staff for the purpose of assessing the staff's baseline knowledge about alarm fatigue and its management.

Knowledge of the proposed interventions was also assessed. Distribution occurred on a one-to-one basis providing an opportunity to speak to the staff about the importance of the project and how its implementation would provide a safer environment for the patient population. Emphasis was also placed on how their contribution to the project could make a significant difference to the quality of care that was provided by the ICU. Upon returning the survey/pre-test, a sweet treat was rewarded to the nurse. The expectation of the survey/pre-test was not that the staff would produce a high score, but to create a sense of urgency about the project. In response to the survey, there were occasions when staff would approach me and inquire about answers to specific questions, thus allowing me to begin a short discussion about the question and other pertinent items regarding alarm management. Also, during the roll out of the survey/pretest two emails were sent to staff and flyers were hung in the staff bathroom reminding the nurses to complete and return the survey.

After a two-week period, 80% of the surveys were returned. Assessment of the surveys indicated that few of the staff knew the high rate of false alerts that occurred or how significantly the number of alert alarms would decrease with the simple change of electrodes on a daily bases. It was also quite surprising to discover the number of staff who was placing the patient's V lead in the incorrect position. Most staff answered correctly that electrodes were to be changed daily, but it is unclear how many actually subscribed to this practice. Results of the survey contributed to the development of the actual education material.

After analyzing the results of the survey/pre-test, deciding what information was most important from my literature reviews, and considering the required corporate information on alarm management, a learning material was formulated (Appendix I). A short quiz to assess the staff's comprehension of the learning material also was developed (Appendix J). The education material and quiz were distributed emphasizing the importance of their completion. Some

questions from the survey/pre-test were repeated on the quiz to emphasize the importance of the content. Staff was paid one half hour of mandatory education time for the completion of the quiz. Ninety-four percent of the staff completed and returned the quiz. Very few completed the quiz with less than 100% correct.

Upon completion of the education process an eight-day audit was done. The auditing consisted of daily rounding of each patient in the unit to check for appropriate lead placement and to speak to the nurse caring for the patient if placement was incorrect or to get general feedback on the process. Auditing of each patient's chart was done to confirm that daily electrode change had occurred. Lastly, using data from the central monitoring, the number of bed alarm and yellow alert alarms that fired in a 24-hour period were tallied. Bed alarms trigger as a result of equipment malfunction or disconnection or as a result of poor signal quality. Yellow alarms trigger when vital signs are identified as outside preset vital sign limits (Koninklijke, 2006). Baseline data indicated that in 24 hours a total of 1,311 alarms alerted. These alerts included 443 yellow alerts, 868 bed alert alarms, and two red alert alarms. Red alert alarms indicate a potentially life threatening condition but were not included in the daily alarm tally as they did not add significantly to the number of alerts fired in a 24 hour period. Upon completion of the auditing process, data showed appropriate lead placement was at 100% and documentation of electrode change every 24 hours was at 50%. Tallied alarm alerts decreased by 6% for bed alarms and 3.2% for yellow alarms. Results of the auditing and signs recognizing staff members who documented a lead change were posted (Appendix K).

Sustainability Plan

The sustainability plan for this project has several aspects. Excellence in care is a core value for the corporation. Decreasing alarm alerts to provide a safer environment is just one aspect of providing excellent care. Education about alarm fatigue and the importance of ECG

lead management to decrease the number of alarms has been shared with the staff of the hospital's emergency department (ED). As the educator for the ICU and the ED, re-education on the process and its importance will be held at the annual-unit specific skills days. Also, as the educator, surveillance for compliance can be incorporated into audits that are currently being performed on other important initiatives. Information from this project has already been shared with the educators of the medical/surgical department, surgical services department, and the family birth/neonatal intensive care unit. Unit specific versions of the information has been developed and distributed to staff on those units. Plans to reinforce education about alarm management, which will include the information from this project, will be done at the annual nursing skills days. Lastly, because this project will be connected to a larger alarm management project in response to The Joint Commission NPSG mandate, it will continue to receive support from all levels of management.

Conclusion

The goal of 100% correct lead placement was met. Electrode change every 24 hours scored at 50% that did not meet the 90% goal (Appendix L). The total number of alarms decreased by 4.6% and did not meet the goal set at 5% (Appendix M). Although the project proceeded with relatively few setbacks, lessons were learned. First, it was assumed that all staff had basic knowledge about appropriate lead placement. That was not the case and although the education material included information about proper placement of the ECG leads, 100% compliance for placement did not occur until later in the audit period.

Next, it was noted that there was not a specific place in the EMR for the staff to chart when they changed electrodes. The section of the record that staff documents baths would prove to be an ideal area to document. Because there is no specific area to document the electrode change, staff is forced to navigate to the event section of the record and free text the information.

A mock up proposal has been submitted to the clinical informaticist that will be presented at the regional Cerner design committee meeting (Appendix N).

Another lesson identified was that there were times no electrodes were changed because some staff did not bathe the patient on a daily basis or the patient was too critically ill to bathe. To address the issue, staff members were consulted. Unfortunately, the staff was divided because some staff wished to designate a shift responsible for the electrode change and others preferred to keep it at the time the patient was bathed. Because the compliance for the electrode change was noted to be highest during the time of the patient's bath, it was decided that that would be the most appropriate time to do the change. Patients with LOS less than 24 hours were excluded from the electrode change audit.

The next lesson came in the form of issues with collecting data on the number of alert alarms that occurred in a 24-hour period. The monitored system used in the ICU is an older generation system that does not generate alarm reports. To gather data, the auditor is required to open each patient window at the central monitor and print a sheet indicating the number of alarms. The report shows alarms divided into red, yellow, and bed alerts. No specific information is given about the individual alert. More in-depth information as to what type of red, yellow, or bed alarm alert can be retrieved from the actual bedside monitor. Unfortunately the waveform of the alert is not available to confirm the accuracy of the alert. Gathering the number of alarm alerts proved to tedious.

Lastly, a positive lesson learned was that the staff is very interested in the project. They frequently ask questions about its progress and are eager to learn more about the next phase of the alarm management project. Text messages and emails have been sent from staff with suggestions to consider improving aspects of the project.

My work on this project has been rewarding because I have learned much about the subject matter and now have a strong start for the next phase of alarm management program. Working through the project has confirmed that, as a CNL, working closely with the staff is the key to a successful program. Communication between the other disciplines, such as leadership, physicians, biomedical staff, and the risk management person was crucial in forming a strong team. My overall takeaway from the project was that CNLs assist the microsystem to navigate a complex healthcare system. They are catalysts for change. This change contributes to cost containment, better outcomes for the patient, increased staff satisfaction, and the promotion of nursing as a profession.

References

- American Association of Colleges of Nursing. (2013). *Competencies and curricular expectations for clinical nurse leader education and practice*. Retrieved from <http://www.aacn.nche.edu/cnl/CNL-Competencies-October-2013.pdf>
- Cvach, M. (2012, July/August). Monitor alarm fatigue. *Biomedical Instrumentation & Technology*. Retrieved from http://s3.amazonaws.com/rdcms-aami/files/production/public/FileDownloads/BIT/JA_alarm_fatigue.pdf
- Darbyshire, J. & Young, D. J. (2013). An investigation of sound levels on intensive care units with reference to the WHO guidelines. *Critical Care*, 17, 1-8. Retrieved from <http://www.biomedcentral.com/content/pdf/cc12870.pdf>
- Edworthy, J. (2012, May-June). Medical audible alarms: A review. *Journal of the American Medical Informatics Association*, 20(3), 584-589. doi: 10.1136/amiajnl-2010-001061
- Emergency Care Research Institute (2014, November). *Top 10 health technology hazards for 2015*. Retrieved from <https://www.ecri.org/resource-center/Pages/Alarms.aspx>
- Koninklijke Philips Electronics. (2006). *IntelliView MP60/MP70 Patient Monitor: Philips M8005A, M8007A Technical Data Sheet*. Netherlands. Retrieved from https://media.supplychain.nhs.uk/media/documents/n0889200/marketing/31990_n0889200.pdf
- Konkani, A., Oakley, B., & Bauld, T. J. (2012). Reducing hospital noise: a review of medical device alarm management. *Biomedical Instrumentation & Technology*, 46(6), 478-487. doi:10.2345/0899-8205-46.6.478
- Phillips, J., Ainsworth, J. Catinella, R., Crumley, C., Ellstrom, K., Fleischman, R., Moffitt, B., Radovich, P., White, A. (2014, June). Alarm fatigue: Strategies to safely manage clinical

alarms and prevent alarm fatigue. *The National Association of Clinical Nurse Specialists*.

Retrieved from <http://www.nacns.org/docs/NACNSFatigueToolkit.pdf>

Sendelbach, S., & Jepsen, S. (2013, May). AACN practice alert: Alarm management. *American Association of Critical Care Nurses*. Retrieved from <http://www.aacn.org/wd/practice/docs/practicealerts/alarm-management-practice-alert.pdf>

State of California Office of Statewide Health Planning & Development. (2014). *Hospital chargemasters and charges for 25 common outpatient procedures*. Retrieved from <http://www.oshpd.ca.gov/Chargemaster/>

The Joint Commission. (2013, April). *Medical device alarm safety in hospitals*. Retrieved from http://www.jointcommission.org/assets/1/18/sea_50_alarms_4_5_13_final1.pdf

The Joint Commission. (2015, January). *National Patient Safety Goals Effective January 1, 2015*. Retrieved from http://www.jointcommission.org/asset/1/6/2015_NPSG_HAP.pdf

Thomason, J. W., Shintani, A., Peterson, J. F., Pun, B. T., Jackson, J. C., Ely, E. W. (2005). Intensive care unit delirium in an independent predictor of longer hospital stay: A prospective analysis of 261 non-vented patients. *Critical Care*, 9(4), 375-381. Retrieved from <http://www.ccforum.com/content/9/4/r375>

University of San Francisco. (2015). *N651: CNL role synthesis: Module 5: Change management*. Retrieved from https://usfca.instructure.com/courses/1552955/pages/module-5-introduction-and-readings?module_item_id=16196993

Vanderveen, T. (2014, November-December). Alarm management: First things first.

Using reliable data to eliminate unnecessary alarms. *Patient Safety & Quality Health*, 11(6), 38-45. Retrieved from <http://psqh.com/november-december-2014/alarm-management-first-things-first>

Appendix A

Alarm Management Survey/Pre-test

Name_____

- 1) How disruptive are false clinical alarms to your daily workflow? (1 = not disruptive at all, 10 constantly disruptive).

1 2 3 4 5 6 7 8 9 10

- 2) In the past year, have you witnessed a delay in response to an urgent patient situation due to excessive false clinical alarms.

True False

- 3) Alarm desensitization or fatigue develops when a person is exposed to an excessive number of alarm alerts.

True False

- 4) Alarm Fatigue can lead to

- a) A delay in response to an alarm alert
- b) The nurse's ability to distinguish high and low alert alarms
- c) The nurse disabling the alarm alert
- d) a and c

- 5) Up to what percentage of electrocardiographic (ECG) monitor alarms are false or clinically insignificant.

- a) 80% - 99%
- b) 65% - 75%
- c) 50% - 60%
- d) 45% - 53%

Appendix A

Alarm Management Survey/Pretest

Page 2

6) Prior to placing electrodes on the patient, skin preparation would include all **except**

- a) Using mild soap and water to clean the skin's surface
- b) Using alcohol pads to clear the skin's surface
- c) Clipping excess hair from the electrode site
- d) Using gentle abrasion to skin where the electrode is to be placed

7) Electrodes should be placed directly over a bony prominence for stability.

True False

8) When applying ECG leads, the brown (V1) lead is placed

- a) Left of the sternal border at the 4th intercostal space (ICS)
- b) Right of the sternal border at the 4th intercostal space (ICS)
- c) Left of the sternal border at the 5th intercostal space (ICS)
- d) Right of the sternal border at the 5th intercostal space (ICS)

9) How often is it recommended that ECG pads be changed

- a) Once a day
- b) Every 2 days
- c) Every 3 days
- d) Only as needed

10) Changing electrodes daily may decrease false alarms by

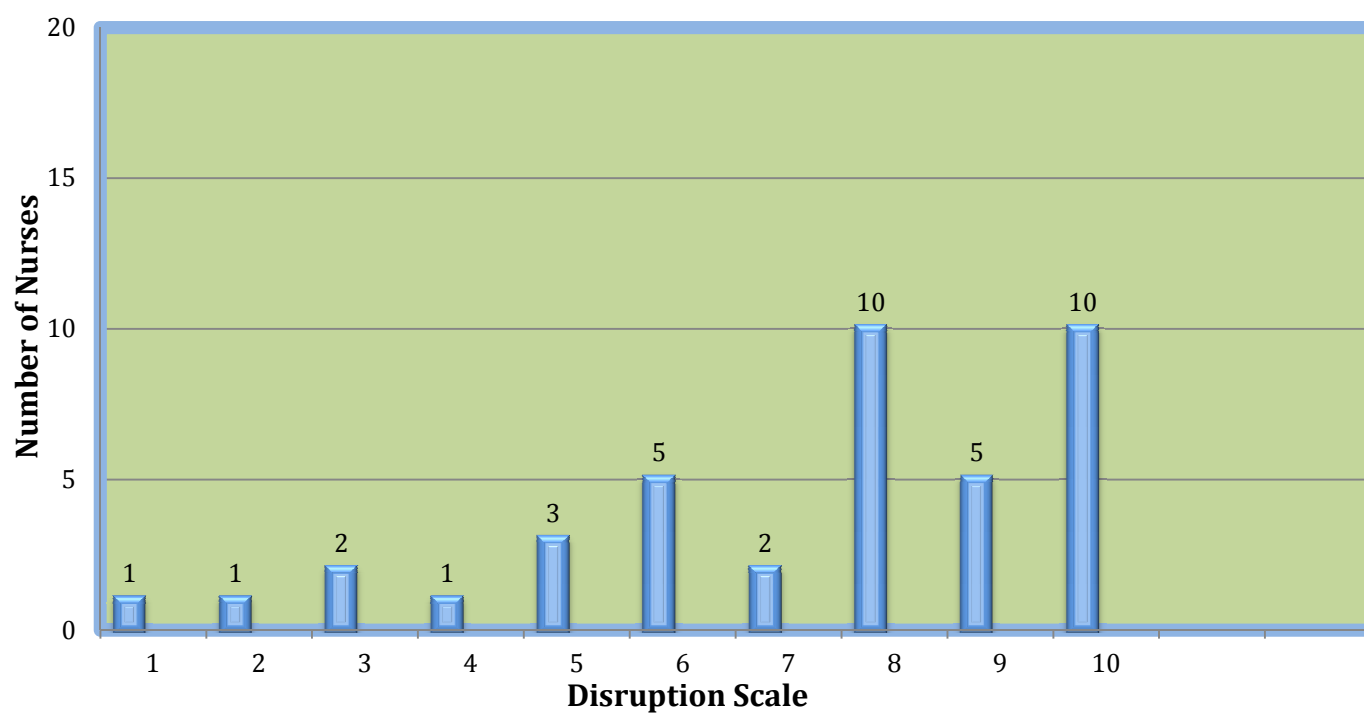
- a) 25 %
- b) 37%
- c) 45%
- d) 46%

d) 46%

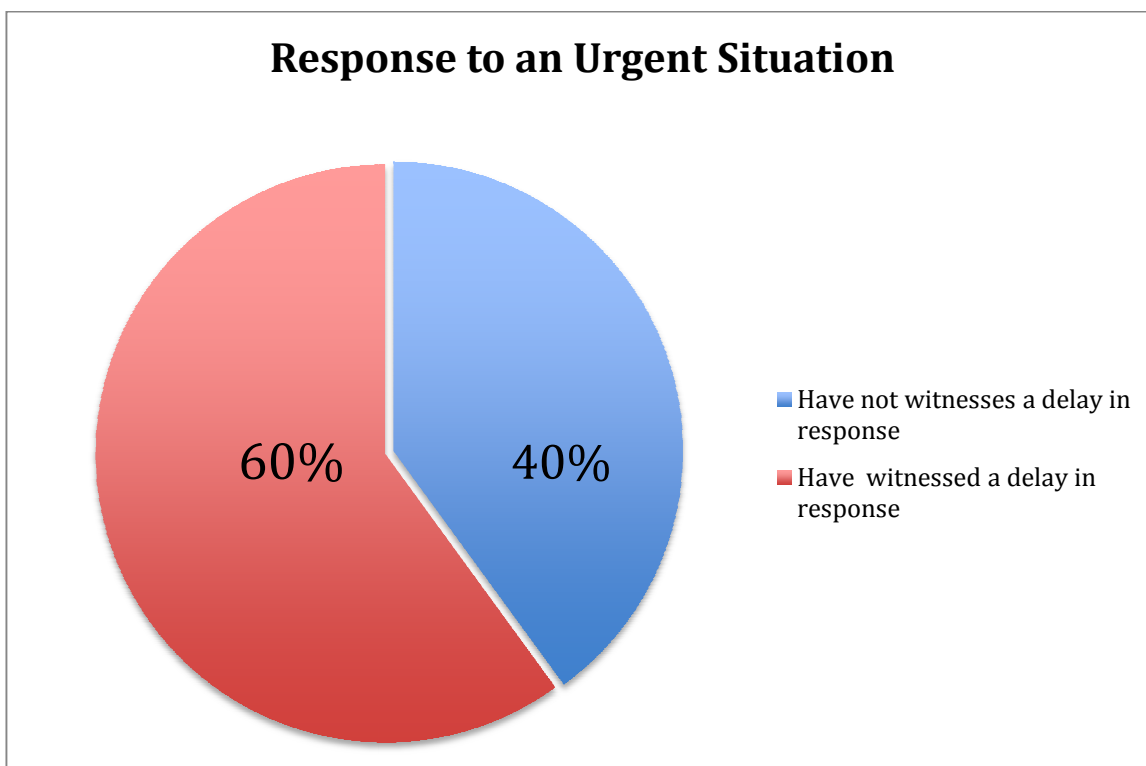
11) Your patient ECG monitor is alarming every 5 to 10 minutes for rhythm pauses > 4 seconds. The patient has identified pauses of greater than 6 seconds, is stable, and current treatment is not required. Is customizing the alarm parameters to decrease nuisance alarm considered appropriate.

True False

Appendix B

Disruptive Alarm Survey Question

Appendix C



Appendix D

**Joint Commission Sentinel Event
Alert Gap Analysis**

Joint Commission Recommendation	Current Practice	Significant Gap?	Actions Taken by hospital
1. Leadership ensures that there is a process for safe alarm management and response in high-risk areas (as identified by the organization).	Clinical alarm policy developed	Yes No X	Formation of a monthly performance improvement team "Improving Alarm Safety"
2. Prepare an inventory of alarm equipment devices used in high-risk areas and for high-risk clinical conditions, and identify the default alarm settings and the limits appropriate for each care area	Areas defined as high risk areas: ED, ICU, Telemetry, OR, PACU, FBC High-risk clinical conditions identified: i.e. ECG monitoring for VTach, VFib, Tachycardias; Fetal monitors; Ventilator; Bipap; Arterial line; Bed alarms	Yes X No	(In Process) Bio Med provided a list of life safety alarm-equipped medical devices. The committee will develop a comprehensive grid that identifies all alarm-equipped medical devices, alarm types, priority status, alarm setting parameters, warning signs etc.
3. Establish guidelines for tailoring alarm settings for individual patients. The guidelines should address situations when limits can be modified to minimize alarm signals and the extent to which alarms can be modified to on; include identification of situations when alarm signals are not clinically necessary.	Clinical Alarm policy "High risk alarms must not be turned off/silenced unless an RN is at bedside providing direct care to the patient. Majority of current alarms are set for default settings and not individual patients	Yes X No	(By August 2015) The committee will develop a comprehensive grid that identifies all alarm-equipment medical devices, alarm types, priority status, alarm settings, parameters, warning signs, etc.

Appendix D

Joint Commission Sentinel Event Alert Gap Analysis
Page 2

Joint Commission Recommendation	Current Practice	Significant Gap?	Actions Taken by hospital
4. Inspect, check and maintain alarm-equipped devices to provide for accurate and appropriate alarm settings, proper operation, and detectability. Base on the frequency of these activities on criteria such as manufactures recommendations, risk levels and current experience	Biomed inspections based on manufacturer recommendations	Yes X No	(To follow implementation of tailoring grid) Audit units to check default settings based on manufacturer recommendations
5. Provide all members of the clinical care team (as defined by the organization), with training on organization's process for safe-alarm management and response in high-risk areas (as defined by the organization), and on the safe use of the alarmed medical device on which they rely. Provide ongoing training on new alarmed medical devices and updates to alarmed medical devices, and ensure that new members of the clinical care team receive training on the alarmed medical devices on which they rely	Unit specific orientation/training Skills Day - review/competency. Unit specific orientation checklist.	Yes X No	The clinical educators will develop education/training materials and distribute as we review each alarm-equipped medical device and determine which equipment needs ongoing annual review at Skills Days
6. To help reduce nuisance alarm signals, change single-use sensors (Ex: ECG leads), according manufacturers recommendations, unless contraindicated		Yes X No	(In process) The committee will be developing a comprehensive grid that identifies all alarm equipped medical devices, alarm types, priority status, alarm settings, parameters, warning signs, etc.

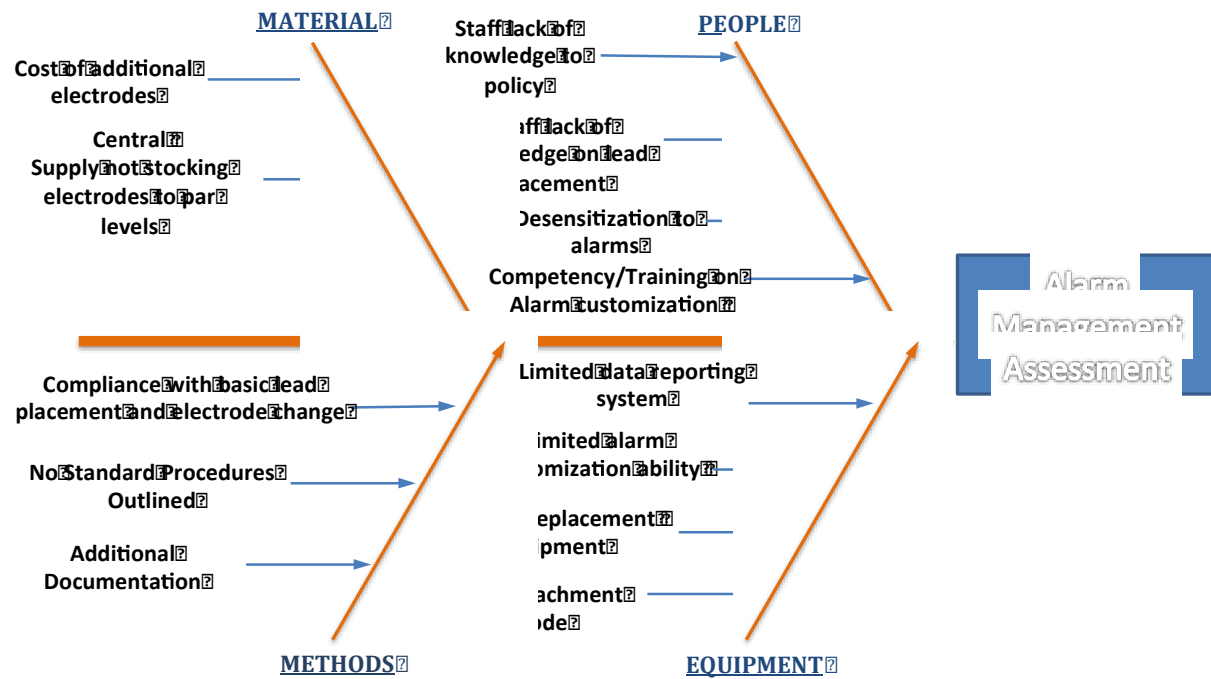
Appendix D

Joint Commission Sentinel Event Alert Gap Analysis
Page 3

Joint Commission Recommendation	Current Practice	Significant Gap?	Actions Taken by hospital
<p>7. Establish a cross-disciplinary team that includes representation from clinical engineering, information technology, and risk management, to address alarm safety and the potential impact of alarm fatigue in all patient care areas</p> <ul style="list-style-type: none"> • Establish a process for continual improvement and constant optimizing of alarm system policies and configurations • Review trends and patterns in alarm-related events to identify opportunities for improving alarm use • Implement an alarm system management policy, including the periodic review of alarm coverage processes and systems, and the development of realistic, implementable strategies to address vulnerabilities 		<p>Yes No X</p>	<p>Formation of a monthly performance improvement team "Improving Alarm Safety. Multidisciplinary team includes: CNO, Risk Manager, Quality Director, Nursing Directors, Clinical Informaticist, Bio Med, Safety officer, front-line staff, and VPMA, when warranted.</p>

Appendix E

Root Cause Analysis Fishbone Graph



Appendix F

SWOT ANALYSIS

STRENGTHS

Need for project confirmed through direct observation

Need for project confirmed through staff survey

Support from leadership for a Joint Commission mandated project

Available resources

Better patient outcome through safety

WEAKNESSES

Lack of staff knowledge on subject matter

Barriers to change process from staff

OPPORTUNITIES

Developed baseline knowledge from project will allow for easier transition for future alarm-management projects

Project process can be shared with other high-risk departments in the hospital

THREATS

Outdated monitoring equipment

Possible loss of long-term support from leadership

Appendix G

Costs

Regional Meetings - Project hospital staff (3 hours x \$70.00 x 5 people) = \$1,050.00
 Meeting Philips Representative- (3 hours x \$70.00) = \$210.00
 Meeting with hospital risk manager (2 hour x \$70.00 x 2 people) = \$280.00
 Developing, distributing, grading, evaluating educational material (12 hours x \$70.00) = \$910.00
 Education hours for staff (70 x .5 x \$60.00) = \$2,100.00
 Rounding and auditing patient's EMR for compliance - (15 hours x \$70.00) = \$1,050.00
 25% increase in electrode use (20/day x .89 cents) = \$18.00/day
 Supplies - \$20.00

Benefits

1) Decreased length of stays due to fewer sleep disturbances that can lead to ICU delirium. In a study of five ICUs done in 2013, environmental noise caused between 11% and 17% of arousals and awakening episodes in patients (Darbyshire & Young, 2013). According to Thomason, Shintani, Peterson, Pun, Jackson & Ely (2005), delirium can develop in up to 48% of the ICU patients, increasing length of stays by one day.

Average number of patients per day in the ICU: 14

Possible patients with delirium: 7 (48%)

Cost per day in ICU: \$10,008.00 (Chargemaster, 2014)

\$10,008.00 x 7 patients - up to \$73,576: Although only a percentage of alarm noise contributes to this amount, its presence is significant.

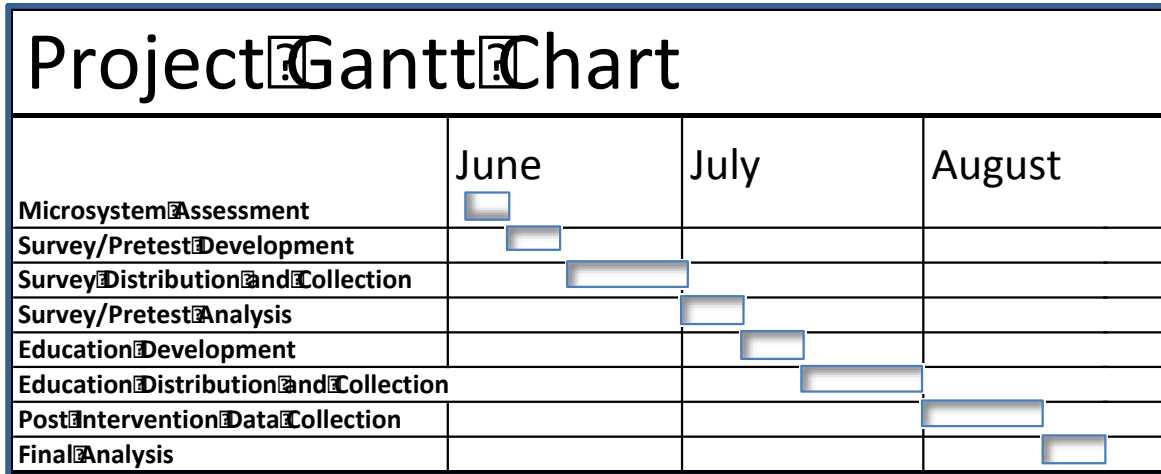
2) Increased response time to alarms as a result of decreased staff alarm fatigue, thus promoting a safe patient environment. Exact benefit data is not available but The Joint Commission reported 98 alarm related events between January 2009 and June 2012 in their Sentinel Event Alert publication (The Joint Commission, 2013).

The calculated benefit

Total Cost = \$5,620.00 + cost of electrodes

Total benefit - An exact amount cannot be calculated, but the total cost of the project is less than one extra day in the ICU for a patient with delirium.

Appendix H



Appendix I

Alarm Management Module

What is alarm fatigue?

Alarm fatigue develops when a person is exposed to an excessive number of alarms. The excess of alarms can lead to sensory overload that can lead to alarm desensitization.

How dangerous is alarm fatigue?

Over a recent four-year period, the FDA received more than 500 reports of patient deaths related to alarm systems on monitoring devices.

The Emergency Care Research Institute (ECRI) identified alarm hazards as number one on their top 10 health technology hazards for 2015.

When asked to rate how disruptive false clinical alarms were to their daily workflow, 1 being not disruptive and 10 being constantly disruptive, 85% of the staff the nurses in the Intensive Care Unit at Methodist Hospital rated the disruption at a 5 or higher.

Sixty percent of this same group of nurses also related that in the past year they had witnessed a delay in response to an urgent patient situation due to excessive false clinical alarms.

Who thinks that alarm fatigue and alarm management is important?

In 2014 the Joint Commission added a new National Patient Safety Goal that addressed reducing harm associated with clinical alarm systems. Elements of the goal include:

- ☐ Requiring hospitals to establish alarm safety as a priority
- ☐ Identifying the most important alarm signals to manage
- ☐ Establishing policies and procedures for managing alarms
- ☐ Educating staff about the purpose and proper operation of alarm systems

The DignityHealth hospitals in the greater Sacramento area have currently:

- ☐ Established alarm safety as a priority
- ☐ Identified the most important signals to manage (Physiologic monitors; pulse oximetry; end tidal CO₂; TCM; ventilators; BiPap; hemodialysis -(see policy for complete list)
- ☐ Developed a Medical Device Alarm Safety policy and procedure
- ☐ Developed a process of educating staff about the purpose and proper operation of alarm systems

What are high-risk areas that require alarm management?

ED, ICU, L&D, monitored units, operative and procedure areas, and PACU

Appendix I

Alarm Management Module
Page 2**What are some basic interventions that can decrease nuisance alarm alerts?**

Some basic interventions that can decrease the number of nuisance alarms are proper skin preparation prior to electrode placement, appropriate lead placement, and daily electrode pad changes.

Why is skin preparation before placing electrodes so important?

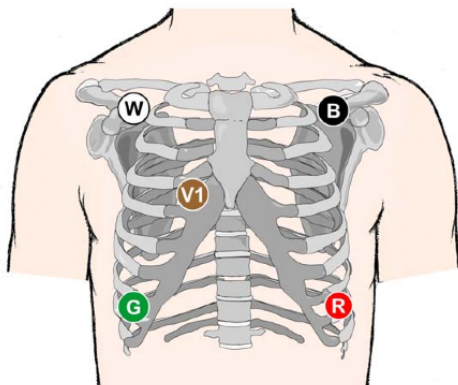
To prepare the skin for electrode placement, dry, dead epidermal layers of skin must be removed, along with any natural oils and dirt that impede electrical flow and creates a resistance to signal quality.

How should skin preparation be done?

- 1) Clip hair from electrode site if necessary
- 2) Clean the area with soap and water or use gentle abrasion with a 4 X 4 gauze pad
- 3) Dry area thoroughly

What is the proper placement method for electrodes?

- 1) For the patient's comfort, attach the lead wire to the electrode before applying the electrode.
- 2) To minimize artifact and maximize the ECG signal strength, avoid major muscle and bony areas.
- 3) Press around the edge of the electrode to apply. Do not press directly on the center of the electrode as it may spread the gel out and create air pockets that contribute to artifact readings.

Where is the proper ECG lead placement?

Ensure the brown precordial lead is placed to the right of the sternal border at the 4th intercostal space

Appendix I

Alarm Management Module
Page 3**Why should electrode pads be changed daily?**

Changing electrode pads prevents pad dryness and poor conductivity. Nuisance bed alarms are decreased because new leads adhere to the skin better.

When is the best time to change the electrodes?

Electrodes are usually changed at the time the patient is bathed, but can be changed at any time and PRN.

Do I have to chart when I change the electrodes?

Yes, you will need to chart your electrode change in the events box in the I-view Flowsheet to monitor compliance.

Appendix J

Alarm Management Module Quiz

Name_____

- 1) Alarm desensitization or fatigue develops when a person is exposed to an excessive number of alarm alerts

True False

- 2) Up to what percentage of ECG monitor alarms are false or clinically insignificant.

- a) 80% - 99%
- b) 65% - 75%
- c) 50% - 60%
- d) 45% - 53%

- 3) Elements of the Joint Commission new 2014 NPSG include

- a) Requiring hospitals to establish alarm safety as a priority
- b) Identifying the most important alarm signals to manage
- c) Establish policies and procedures for managing alarms
- d) Educating staff about the purpose and proper operation of alarm systems
- e) All except d
- f) All of the above

- 4) Identified high risk areas that require alarm management include (circle all that apply)

- a) ICU
- b) OPS
- c) ED
- d) Labor & Delivery

- 5) Physiologic monitors, pulse oximetry, end tidal CO₂, and ventilators are considered important alarm alerts to manage

True False

- 6) Prior to placing electrodes on the patient, skin preparation would include all **except**

- a) Using mild soap and water to clean the skin's surface
- b) Using alcohol pads to clear the skin's surface
- c) Clipping excess hair from the electrode site
- d) Using gentle abrasion to the skin where the electrode is to be placed

Appendix J

Alarm Management Module Quiz

Page 2

7) Electrodes should not be place directly over a bony or muscle areas on the body

True False

8) When applying ECG leads, the brown (V1) lead is placed

- a) Left of the sternal border at the 4th intercostal space (ICS)
- b) Right of the sternal border at the 4th intercostal space (ICS)
- c) Left of the sternal border at the 5th intercostal space (ICS)
- d) Right of the sternal border at the 5th intercostal space (ICS)

9) How often is it recommended that ECG pads be changed

- a) Once a day
- b) Every 2 days
- c) Every 3 days
- d) Only as needed

10) Changing electrodes daily may decrease false alarms by

- a) 25 %
- b) 37%
- c) 46%
- d) 47%

11) Charting for daily electrode changes is done in the Cardiac Rhythm section of the IView Flowsheet

True False

Appendix K

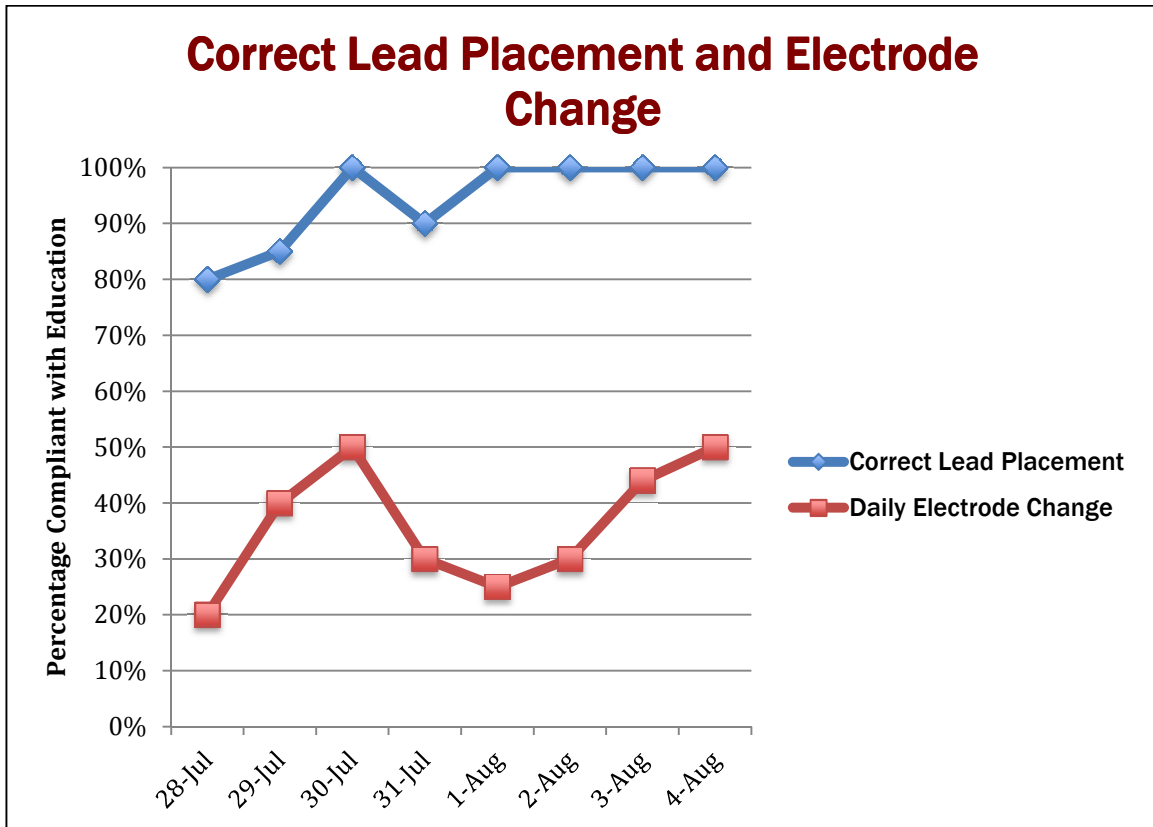
Staff Recognition Sign

2, 4, 6, 8- Who do we appreciate!
ELLYN, CHERRY, ELAINE, AND
BUHYNE!!!

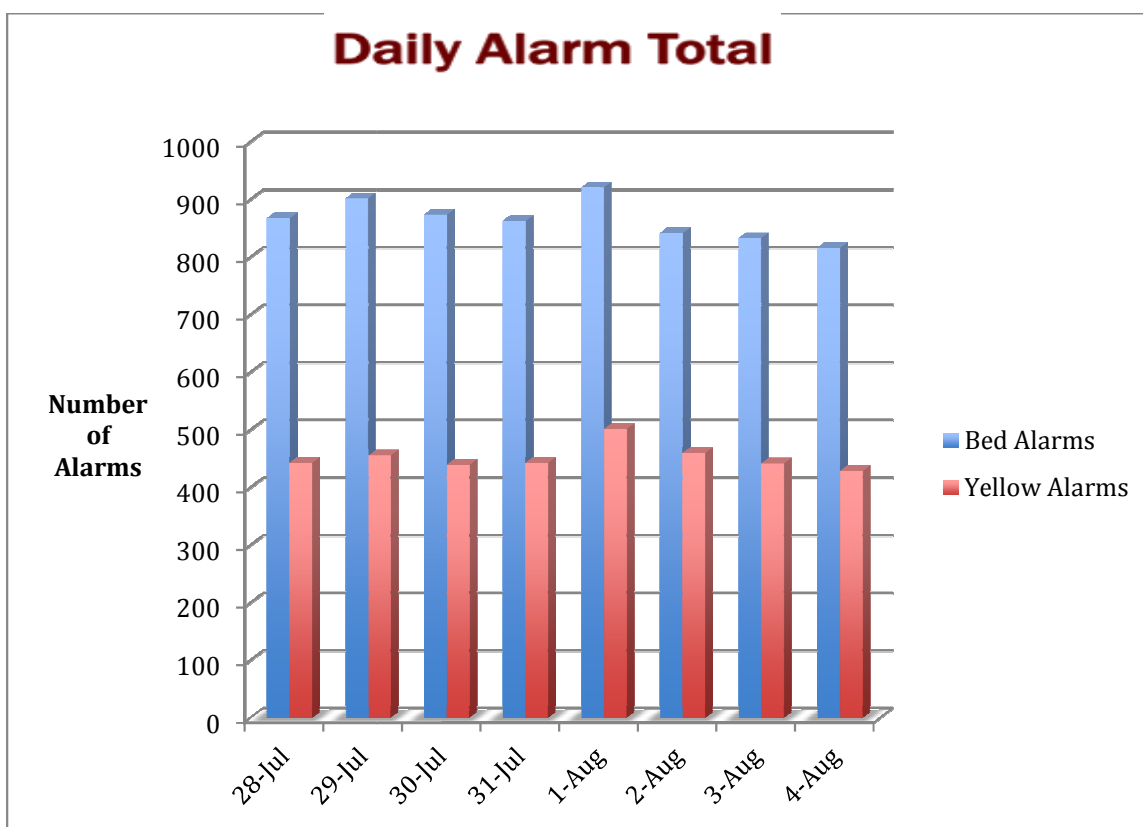


They charted the electrode
change on their patient!

Appendix L



Appendix M



Appendix N

Cerner Change Request Mock Up

Requested addition of "Electrodes changed"
to ADL portion the flowsheet

	14:00 - 14:59 PDT	13:00 - 13:59 PDT	12:00 - 12:59 PDT	11:00 - 11:59 PDT	10:00 - 10:59 PDT	09:00 - 09:59 PDT	08:00 - 08:59 PDT	07:00 - 07:59 PDT	06:00 - 06:59 PDT	05:00 - 05:59 PDT	04:00 - 04:59 PDT	03:00 - 03:59 PDT	02:00 - 02:59 PDT	01:00 - 01:59 PDT	00:00 - 00:59 PDT	23:00 - 23:59 PDT	22:00 - 22:59 PDT
08/06/15																	08/05/15
ADLs																	
ADLs Assess/Reassess																	
Activity Status																	
Ambulation																	
Ambulatory Frequency																	
Chair Duration minutes																	
Position																	
HOB degrees																	
Linen Change																	
Assistive Devices																	
Last BM																	
Stool Guaiac																	
Stool Q/C Passed																	
Bath/Shower																	
Antimicrobial Bath Clea...																	
SURGICAL PREP DONE																	
Catheter Care																	
Peri Care																	
Oral Care																	
Shave																	
Preventive Skin Care																	
Shampoo																	
Seizure Precautions																	
Suicide Precautions ADLs																	
Bed Locked/Low Position																	
Call Light Within Reach																	
Side Rails Up X2																	
All Alarms Audible																	

Current

	14:00 - 14:59 PDT	13:00 - 13:59 PDT	12:00 - 12:59 PDT	11:00 - 11:59 PDT	10:00 - 10:59 PDT	09:00 - 09:59 PDT	08:00 - 08:59 PDT	07:00 - 07:59 PDT	06:00 - 06:59 PDT	05:00 - 05:59 PDT	04:00 - 04:59 PDT	03:00 - 03:59 PDT	02:00 - 02:59 PDT	01:00 - 01:59 PDT	00:00 - 00:59 PDT	23:00 - 23:59 PDT	22:00 - 22:59 PDT
08/06/15																	08/05/15
ADLs																	
ADLs Assess/Reassess																	
Activity Status																	
Ambulation																	
Ambulatory Frequency																	
Chair Duration minutes																	
Position																	
HOB degrees																	
Linen Change																	
Assistive Devices																	
Last BM																	
Stool Guaiac																	
Stool Q/C Passed																	
Bath/Shower																	
Antimicrobial Bath Clea...																	
<u>Electrodes changed</u>																	
SURGICAL PREP DONE																	
Catheter Care																	
Peri Care																	
Oral Care																	
Shave																	
Preventive Skin Care																	
Shampoo																	
Seizure Precautions																	
Suicide Precautions ADLs																	
Bed Locked/Low Position																	
Call Light Within Reach																	

Requested Change